

**AMENDMENTS TO THE DRAWINGS:**

The attached two sheets of drawings includes changes to Figure 2 and 3. These sheets which include Figures 1, 2, and 3, replace the original sheets including Figures 1, 2, and 3.

Attachment: Replacement Sheets

REMARKS

Favorable reconsideration is respectfully requested in view of the foregoing amendments and the following remarks.

Applicants thank Examiner Roberts Culbert for his time and consideration of the present application during the telephone interviews with Jay F. Williams, Reg. No. 48,036, on February 4 and 5, 2009.

The specification and Figures 2 and 3 have been amended to convert European numeric notation to U.S. numeric notation: For example, "1,54" shown in Figure 2 now reads "1.54". See the "AMENDMENT TO THE SPECIFICATION", "AMENDMENT TO THE DRAWINGS", and the APPENDIX of this amendment. The specification and drawings are amended as to form only, and no new matter has been added.

**I. Claim Status & Amendments**

Claims 1-17 were pending in this application when last examined and stand rejected.

Claims 1-2, 6-7, 9-10, and 16 are cancelled without prejudice or disclaimer thereto. Applicants reserve the right to file a continuation or divisional on any cancelled subject matter.

Claims 3-4, 8, 11, and 13 are amended to change their dependency to claim 17, which is now the sole independent claim.

Claims 3-5, 8, 11-15, and 17 are pending upon entry of this amendment.

By way of the present amendment, Applicants have merely cancelled certain claims and revised the dependency of others. It is believed that the present amendment does not present any new issues for consideration and/or search as the amended claims correspond to subject matter already considered by the Office. Thus, if the next Office Action on the merits includes a new ground of rejection of one or more claims, the Action must be non-final.

## **II. Obviousness Rejections**

Claims 1-8 and 11-16 were rejected under 35 U.S.C. § 103(a) as obvious over CHRISTENSEN (US 2003/0235985) in view of TANAKA (US 5,032,217) for the reasons on pages 3-4 of the Office Action.

Claims 9, 10, and 17 were rejected under 35 U.S.C. § 103(a) as obvious over CHRISTENSEN in view of TANAKA in view of BUCHANAN (US 2003/0230549) for the reasons on page 4 of the Action.

The rejections should fall, because the cited prior art references fail to teach, suggest or make obvious all of the limitations of claim 17 (which is the sole independent claim), as required to support a *prima facie* case of obviousness.

Claim 17, which is the sole independent claim, is directed to "a method of selective etching." The method includes one step of "providing a first material on a substrate, wherein said first material is  $\text{HfO}_2$  or  $\text{ZrO}_2$ , and said first material is pretreated with an energetic particle bombardment." Another step includes "providing a second material on the substrate." The method then requires yet another step of "selectively etching said first material with a selectivity of at least 2:1 towards said second material by dispensing a liquid etchant onto the substrate surface and generating a flow having a mean velocity  $v$  parallel to the surface of the substrate of at least 0.1 m/s." In the claimed method, "liquid etchant is dispensed in a continuous flow as a free beam or as a liquid stream onto the substrate and spreads over the surface of the substrate."

To start, CHRISTENSEN fails to disclose or suggest the step of "selectively etching said first material with a selectivity of at least 2:1 towards said second material by dispensing a liquid etchant onto the substrate surface and generating a flow having a mean velocity  $v$  parallel to the surface of the substrate of at least 0.1 m/s" of claim 17. Indeed, at paragraph [0043], CHRISTENSEN states:

"The similarity between etch results noted below in the examples utilizing a small, static volume of etching solution and a centrifugal spray processor with high cross-wafer flow rates indicates that the flow rate of etching solution over the wafer is not critical." [Emphasis added.]

Thus, CHRISTENSEN clearly teaches that the flow rate of etching solution over the wafer is not critical. This stands in contrast to the claimed method, wherein the Applicants found that the cross-wafer flow rate of etching solution over the wafer is critical.

When this point was raised in the interview, the Examiner argued that it would have been routine to optimize the flow rate based on the teachings of the cited references. Applicants respectfully disagree.

It is well established that only result-effective variables can be optimized. Moreover, a particular parameter must first be recognized as a result-effective variable (i.e., a variable which achieves a recognized result), before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977); *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980); and MPEP § 2144.05 II, B. It is clear from the last sentence in paragraph [0043] that CHRISTENSEN did not recognize that the flow rate is a result-effective variable. If CHRISTENSEN (who is a person skilled in the art) had realized this relevancy, he would have stated such differently (for example, "increasing the cross-wafer flow increases selectivity". But he did not do so.

Again, CHRISTENSEN discloses that "the flow rate of etching solution over the wafer is not critical." Since

CHRISTENSEN did not recognize that the flow rate is critical, there can be no optimization of the flow rate based on the teachings in CHRISTENSEN, even if combined with TANAKA or BUCHANAN. This effectively rebuts the Examiner's position in the interview that it would have been routine to optimize the flow rate to arrive at the claimed invention.

As further evidence that it would not have been routine to optimize the flow rate, CHRISTENSEN uses an immersion or spray method technique to dispense the liquid etchant. There is simply no liquid etchant flow rate to optimize when using the immersion or spray method technique of CHRISTENSEN, because there is no flow of the etchant solution. Instead, the immersion technique in CHRISTENSEN corresponds to submerging the wafer into the liquid etchant and the spray technique results in droplets. Neither technique in CHRISTENSEN results in the liquid etchant being dispensed in a continuous flow as a free beam or as a liquid stream as required by claim 17.

For the above reasons, CHRISTENSEN cannot be relied upon for the position that it would be routine to optimize the flow rate.

Yet, during the interview, the Examiner noted that CHRISTENSEN mentions dispensing techniques other than immersion or spray. The Examiner also relied on TANAKA and BUCHANNAN as allegedly disclosing the other techniques. However, this does not

negate the clear teaching that CHRISTENSEN indicates flow rate is not critical (see the discussion above).

Furthermore, as discussed in the interview, the claimed method achieves surprising and unexpected results over the cited prior art references that are indicative of the non-obviousness of the claims. In this regard, Applicants' claimed method achieves surprisingly higher selectivity using  $\text{HfO}_2$ , versus silicon dioxide  $\text{SiO}_2$ , as used in CHRISTENSEN (paragraphs [0023-0027] and the abstract in CHRISTENSEN). See, for instance, Figures 2-3 and paragraphs [030], [040], and [041] of the instant specification, in which it is disclosed that

"the etch rate of  $\text{HfO}_2$  only decreases by a factor of 1,3, whereas it drastically changes by a factor of 9 for  $\text{ThxO}$ . Hence, as stated in the specification "the etch selectivity of  $\text{HfO}_2$  (annealed and pretreated) towards  $\text{ThOx}$  increased from 12:1 to 88:1. This improvement of selectivity of a factor of 7 is extraordinary." [Emphasis added.]

It is believed that such unexpected and surprising properties are further evidence of the non-obviousness of the claimed method.

Yet, during the interview, the Examiner argued that Applicants' velocity is not unusual because it falls within the parameters of TANAKA. Applicants respectfully disagree and believe that it is unexpected, especially in view of the above-noted deficiencies in CHRISTENSEN, and because CHRISTENSEN teaches away from the claimed method as discussed below.

A further difference between CHRISTENSEN and the method of the instant application is that CHRISTENSEN etches  $\text{Hf}_x\text{Si}_y\text{O}_z$  or  $\text{Zr}_x\text{Si}_y\text{O}_z$ , whereas in the claimed method, Applicants etch  $\text{HfO}_2$  or  $\text{ZrO}_2$  as a first material that has been pretreated with an energetic particle bombardment. Such a difference in methodology could account for the reason Applicants experienced a different influence on velocity flow and selectivity. Independent claim 17 emphasizes this difference. It is noted that the mention of  $\text{HfO}_2$  in CHRISTENSEN does not imply whether it is an untreated, annealed, or bombarded  $\text{HfO}_2$ .

As discussed in the interview, CHRISTENSEN (paragraph [0022]) seemingly teaches away from etching using  $\text{HfO}_2$  and  $\text{ZrO}_2$ . In reply, the Office argued that paragraph [0022] of CHRISTENSEN does not teach away, because Applicants do not have  $\text{HfO}_2$  due to ion bombardment in the claimed method. However, the Office's position is incorrect. It should be noted that ion bombardment (i.e., mechanical cracking) does not change  $\text{HfO}_2$  into a new composition. In other words, it does not change the chemical nature of  $\text{HfO}_2$  and  $\text{ZrO}_2$ . This stands in contrast to the Office's position.

Also, CHRISTENSEN found that decreasing fluoride ion concentration increases his selectivity because this decreases etch rate. This was CHRISTENSEN's way of increasing selectivity and it stands in contrast to the claimed method.



Based on the above, it is respectfully submitted that the primary reference of CHRISTENSEN fails to disclose or suggest each and every element of the claims, and in fact, teaches away from the claimed method. Further, the claimed method achieves surprising and unexpected results over CHRISTENSEN.

The secondary references of TANAKA and BUCHANNAN fail to remedy the above-noted deficiencies in CHRISTENSEN. In this regard, TANAKA and BUCHANNAN do not discuss the significance of the flow rate. Nor do these references disclose the recited high flow velocity of the method of claim 17.

Accordingly, when starting with BUCHANNAN or TANAKA, the skilled artisan would not look to CHRISTENSEN, because CHRISTENSEN says flow rate is not critical. In other words, the skilled artisan would not think to combine CHRISTENSEN with BUCHANNAN and/or TANAKA to arrive at the claimed invention.

Even if CHRISTENSEN was combined with the other references, CHRISTENSEN would lead the skilled artisan to the conclusion that the flow rate need not be optimized. This further supports the position that it would not have been routine to optimize the flow rate to arrive at the claimed method.

For these reasons, it is believed that the combined references fail to disclose or suggest the step of "selectively etching said first material with a selectivity of at least 2:1 towards said second material by dispensing a liquid etchant onto the substrate surface and generating a flow having a mean

velocity  $v$  parallel to the surface of the substrate of at least 0.1 m/s" of claim 17.

In view of the above, Applicants respectfully submit that the Office has failed to show that the combination of CHRISTENSEN, TANAKA and BUCHANAN could provide for all the elements of claim 17 and that one skilled in the art could have combined the prior art teachings by known methods with no change in their respective functions to yield predictable results and arrive at the claimed method. Thus, Applicants respectfully submit that neither CHRISTENSEN nor TANAKA nor BUCHANAN nor any combination thereof discloses or suggests each and every element of independent claim 17.

For these reasons, claim 17 is believed to be novel and non-obvious over CHRISTENSEN, alone or when combined with BUCHANAN and/or TANAKA. Likewise, the dependent claims are also novel and unobvious over the combined references in view of their dependency on claim 17.

Thus, withdrawal of the obviousness rejections is solicited.

### **III. Conclusion**

In view of the foregoing amendments and remarks, it is respectfully submitted that the present application is in condition for allowance and notice to that effect is respectfully requested. If the Examiner has any comments or proposals for

expediting prosecution, please contact the undersigned attorney at the telephone number below.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

YOUNG & THOMPSON

/Robert A. Madsen/  
Robert A. Madsen, Reg. No. 58,543  
209 Madison Street, Suite 500  
Alexandria, VA 22314  
Telephone (703) 521-2297  
Telefax (703) 685-0573  
(703) 979-4709

RAM/jr

**APPENDIX:**

The Appendix includes the following item(s):

- ☒ - two Replacement Sheets for Figures 1, 2 and 3 of the drawings